CLAIMS

1.   A method of protecting computer data, said method comprising the steps of:

       acquiring a first state snapshot S_1 of a first data volume consistent state at a time t_1;

       acquiring a second state snapshot S_2 of a second data volume consistent state at a time $t_2 > t_1$;

       generating a first precedent snapshot difference list S_{21} comprising an identification of data blocks of said first state snapshot S_1 differing from data blocks in said second state snapshot S_2; and

       creating a first precedent backup B_{21} by copying from said first state snapshot S_1 data blocks identified in said first precedent snapshot difference list S_{21}, said first precedent backup B_{21} further comprising said first precedent snapshot difference list S_{21}.

2.   The method of claim 1 further comprising the step of storing said first precedent backup B_{21} in an offline memory means.

3.   The method of claim 2 wherein said offline memory means comprises at least one member from the group consisting of magnetic tape and optical disk.

4.   The method of claim 1 further comprising the step of deleting said first state snapshot S_1 following said step of generating a first precedent snapshot difference list S_{21}.

1   5.   The method of claim 2 further comprising the steps of:

2   retrieving said first precedent backup B_{21};

3   recovering said first precedent snapshot difference list S_{21} from said first

4   precedent backup B_{21}; and

5   restoring said first state snapshot S_1 by overwriting at least a portion of said

6   second state snapshot S_2 with the contents of said first precedent

7   backup B_{21}.

1   6.   The method of claim 1 further comprising the steps of:

2   acquiring a third state snapshot S_3 of a third data volume consistent state at a

3   time $t_3 > t_2$;

4   generating a second precedent snapshot difference list S_{32} comprising an

5   identification of data blocks of said second state snapshot S_2 differing

6   from data blocks in said third state snapshot S_3; and

7   creating a second precedent backup B_{32} by copying from said second state

8   snapshot S_2 data blocks identified in said second precedent snapshot

9   difference list S_{32}, said second precedent backup B_{32} further

10   comprising said second precedent snapshot difference list S_{32}.

1   7.   The method of claim 6 further comprising the step of storing said second

2   precedent backup B_{32} in an offline memory means.

1   8.   The method of claim 6 further comprising the step of deleting said second state

2   snapshot S_2 following said step of generating a second precedent snapshot difference list

3   S_{32}.

1   9.   The method of claim 6 further comprising the steps of:

2   recovering said second precedent snapshot difference list S_{32} from said

3   second precedent backup B_{32}; and

4   restoring said second state snapshot S_2 by overwriting at least a portion of

5   said third state snapshot S_3 with the contents of said second precedent

6   backup B_{32}.

1   10.   The method of claim 6 further comprising the steps of:

2   generating a concatenated precedent snapshot difference list S_{31} comprising

3   an identification of said data blocks of said second state snapshot S_2

4   differing from data blocks in said third state snapshot S_3 and an

5   identification of said data blocks of said first state snapshot S_1 differing

6   from data blocks in said second state snapshot S_2;

7   creating a concatenated backup B_{31} by copying all said blocks in said first

8   precedent backup B_{21} and copying all blocks in said second precedent

9   backup B_{32} not present in said first precedent backup B_{21};

10   copying said first precedent snapshot difference list S_{21} and said second

11   precedent snapshot difference list S_{32} into said concatenated backup

12   B_{31}; and

13   storing said concatenated backup B_{31} in an offline memory means.

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1   11.   The method of claim 10 further comprising the steps of:

2   retrieving said concatenated backup B_{31};

3   recovering said concatenated precedent snapshot difference list S_{31} from said

4   concatenated backup B_{31}; and

5   restoring said first state snapshot S_1 by overwriting at least a portion of said

6   third state snapshot S_3 with the contents of said concatenated backup

7   B_{31}.

1   12.   The method of claim 10 further comprising the steps of:

2   acquiring a fourth state snapshot S_4 of a fourth data volume consistent state

3   at a time $t_4 > t_3$;

4   generating a third precedent snapshot difference list S_{43} comprising an

5   identification of data blocks of said third state snapshot S_3 differing

6   from data blocks in said fourth state snapshot S_4;

7   creating a third precedent backup B_{43} by copying from said third state

8   snapshot S_3 data blocks identified in said third precedent snapshot

9   difference list S_{43}, said third precedent backup B_{43} further comprising

10   said third precedent snapshot difference list S_{43}.

11   generating a concatenated precedent snapshot difference list S_{42} comprising

12   an identification of said data blocks of said third state snapshot S_3

13   differing from data blocks in said fourth state snapshot S_4 and an

14   identification of said data blocks of said second state snapshot S_2

15   differing from data blocks in said third state snapshot S_3;

16   creating a concatenated backup B_{42} by copying all said blocks in said second

17   precedent backup B_{32} and copying all blocks in said third precedent

18   backup B_{43} not present in said second precedent backup B_{32}, and

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19   copying said second and third precedent difference lists S_{32} and S_{43}

20   into said concatenated backup B_{42}; and

21   creating a concatenated backup B_{41} by copying all said blocks in said first

22   precedent backup B_{21} and copying all blocks in said concatenated

23   backup B_{42} not present in said first precedent backup B_{21}, and copying

24   first, second, and third precedent difference lists S_{21}, S_{32}, and S_{43}, into

25   said concatenated backup B_{41}.

1   13.   The method of claim 12 further comprising the steps of:

2   retrieving said concatenated backup B_{41};

3   recovering said concatenated precedent snapshot difference list S_{41} from said

4   concatenated backup B_{41}; and

5   restoring said first state snapshot S_1 by overwriting at least a portion of said

6   fourth state snapshot S_4 with the contents of said concatenated backup

7   B_{41}.

1   14.   A method of protecting computer data, said method comprising the steps of:

2   acquiring a base state snapshot S_0 of a data volume base state at a time t_0;

3   creating a base state backup B_0 of said base state snapshot S_0;

4   acquiring a first state snapshot S_1 of a first data volume consistent state at a

5   time $t_1 > t_0$;

6   generating a first succedent snapshot difference list S_{01} comprising an

7   identification of data blocks of said first state snapshot S_1 differing

8   from data blocks in said base state snapshot S_0;

9   creating a first succedent backup B_{01} by copying from said first state

10   snapshot S_1 data blocks identified in said first succedent snapshot

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11   difference list S_{01}, and copying said first succedent snapshot difference

12   list S_{01}; and

13   deleting at least a portion of said first state snapshot S_1.

1   15.   The method of claim 14 further comprising the step of storing said base state

2   backup B_0 and said first succedent backup B_{01} in an offline memory means.

1   16.   The method of claim 15 further comprising the steps of:

2   retrieving said base state backup B_0 and said first succedent backup B_{01};

3   recovering said base state snapshot S_0 and said first succedent snapshot

4   difference list S_{01} from said base state backup B_0 and said first

5   succedent backup B_{01}, respectively; and

6   restoring said first state snapshot S_1 by overwriting said base state snapshot

7   S_0 with said first succedent backup B_{01}.

1   17.   The method of claim 14 further comprising the steps of:

2   acquiring a second state snapshot S_2 of a second data volume consistent state

3   at a time $t_2 > t_1$;

4   generating a second succedent snapshot difference list S_{12} comprising an

5   identification of data blocks of said second state snapshot S_2 differing

6   from data blocks in said first state snapshot S_1;

7   creating a second succedent backup B_{12} by copying from said second state

8   snapshot S_2 data blocks identified in said second succedent snapshot

9   difference list S_{12}, and copying said second succedent snapshot

10   difference list S_{12}; and

11   deleting at least a portion of said second state snapshot S_2.

1   18.   A method of protecting computer data, said method comprising the steps of:

2   acquiring a base state snapshot S_0 of a data volume base state at a time t_0;

3   acquiring a first state snapshot S_1 of a first data volume consistent state at a

4   time $t_1 > t_0$;

5   acquiring a second state snapshot S_2 of a second data volume consistent state

6   at a time $t_2 > t_1$;

7   generating a first succedent snapshot difference list S_{01} comprising an

8   identification of data blocks of said first state snapshot S_1 differing

9   from data blocks in said base state snapshot S_0;

10   generating a first precedent snapshot difference list S_{21} comprising an

11   identification of data blocks of said first state snapshot S_1 differing

12   from data blocks in said second state snapshot S_2;

13   creating a first composite backup C_{012} by copying from said first state

14   snapshot S_1 data blocks identified in first succedent snapshot

15   difference list S_{01} and copying from said first state snapshot S_1 data

16   blocks identified in said first precedent snapshot difference list S_{21};

17   and

18   copying said first succedent snapshot difference list S_{01} and said first

19   precedent snapshot difference list S_{21} into said first composite backup

20   C_{012}.

1   19.   The method of claim 18 further comprising the step of storing said first composite

2 backup C_{012} in an offline memory means.

1   20.   The method of claim 19 further comprising the steps of:

2   retrieving said first composite backup C_{012};

3   recovering said first precedent snapshot difference list S_{21}; and

4   restoring said first state snapshot S_1 by overwriting at least a portion of said

5   second state snapshot S_2 with at least a portion of the contents of said

6   first composite backup C_{012}.

1   21.   The method of claim 18 further comprising the steps of:

2   acquiring a third state snapshot S_3 of a third data volume consistent state at a

3   time $t_3 > t_2$;

4   generating a second succedent snapshot difference list S_{12} comprising an

5   identification of data blocks of said second state snapshot S_2 differing

6   from data blocks in said first state snapshot S_1;

7   generating a second precedent snapshot difference list S_{32} comprising an

8   identification of data blocks of said second state snapshot S_2 differing

9   from data blocks in said third state snapshot S_3;

10   creating a second composite backup C_{123} by copying from said second state

11   snapshot S_2 data blocks identified in second succedent snapshot

12   difference list S_{12} and copying from said second state snapshot S_2 data

13   blocks identified in said second precedent snapshot difference list S_{32};

14   and

15   copying said second succedent snapshot difference list S_{12} and said second

16   precedent snapshot difference list S_{32} into said second composite

17   backup C_{123}.

1   22.   The method of claim 21 further comprising the step of storing said second

2   composite backup C_{123} in an offline memory means.

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1   23.   The method of claim 18 further comprising the steps of:

2   acquiring a plurality of third through n^{th} state snapshots S_3 through S_n of

3   third through n^{th} data volume consistent states at respective times

4              $t_3 < \cdots t_j \cdots \le t_n$;

5   generating second through $(n-1)^{th}$ succedent snapshot difference lists S_{12}

6   through $S_{(n-2)(n-1)}$ respectively, a $(j-1)^{th}$ succedent snapshot

7   difference list $S_{(j-2)(j-1)}$ comprising an identification of data blocks of a

8              $(j-1)^{th}$ state snapshot $S_{(j-1)}$ differing from data blocks in a $(j-2)^{th}$

9   state snapshot $S_{(j-2)}$;

10   generating second through $(n-1)^{th}$ precedent snapshot difference lists S_{32}

11   through $S_{(n)(n-1)}$ respectively, a $(j-1)^{th}$ precedent snapshot difference

12   list $S_{(j)(j-1)}$ comprising an identification of data blocks of a $(j-1)^{th}$

13   state snapshot $S_{(j-1)}$ differing from data blocks in a jth state snapshot

14   S_j;

15   creating second through $(n-1)^{th}$ composite backups C_{123} through

16              $C_{(n-2)(n-1)(n)}$, wherein a $(j-1)^{th}$ composite backup $C_{(j-2)(j-1)(j)}$ is

17   created by copying from said $(j-1)^{th}$ state snapshot $S_{(j-1)}$ data blocks

18   identified in said $(j-1)^{th}$ succedent snapshot difference list $S_{(j-2)(j-1)}$

19   and copying from said $(j-1)^{th}$ state snapshot $S_{(j-1)}$ data blocks

20   identified in said $(j-1)^{th}$ precedent snapshot difference list $S_{(j)(j-1)}$;

21   and

22   copying said succedent snapshot difference lists S_{12} through $S_{(n-2)(n-1)}$ and

23   said precedent snapshot difference lists S_{32} through $S_{(n)(n-1)}$ into said

24   respective composite backups C_{123} through $C_{(n-2)(n-1)(n)}$.

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1   24.   The method of claim 23 further comprising the step of storing one or more of said

2   second through $(n-1)^{th}$ composite backups C_{123} through $C_{(n-2)(n-1)(n)}$ in an offline

3   memory means.

1   25.   The method of claim 23 further comprising the step of deleting said third through

2    $(n-1)^{th}$ state snapshots S_3 through S_{n-1}.

1   26.   The method of claim 23 further comprising the steps of:

2   assigning a unique identifier to each said state snapshot S_j;

3   for each said composite backup $C_{(j-2)(j-1)(j)}$, identifying said state snapshots

4           $S_{(j-2)}$ and S_j as difference snapshots and said $(j-1)^{th}$ state snapshot

5           $S_{(j-1)}$ as a content snapshot;

6   for each said composite backup $C_{(j-2)(j-1)(j)}$, copying the unique identifiers of

7   said state snapshots $S_{(j-2)}$, $S_{(j-1)}$, and S_j into said $(j-1)^{th}$ composite

8   backup $C_{(j-2)(j-1)(j)}$.

1   27.   The method of claim 26 further comprising the steps of:

2   retrieving said $(j-1)^{th}$ composite backup $C_{(j-2)(j-1)(j)}$;

3   recovering said $(j-1)^{th}$ precedent snapshot difference list $S_{(j)(j-1)}$ from said

4           $(j-1)^{th}$ composite backup $C_{(j-2)(j-1)(j)}$; and

5   restoring said $(j-1)^{th}$ state snapshot S_{j-1} by overwriting at least a portion of

6   said j^{th} state snapshot S_j with the contents of said $(j-1)^{th}$ composite

7   backup $C_{(j-2)(j-1)(j)}$.

1   28.   The method of claim 26 further comprising the step of comparing the unique

2   identifier of said j^{th} snapshot S_j to the unique identifiers of the difference snapshots of

3   said $(j-1)^{th}$ composite backup $C_{(j-2)(j-1)(j)}$.

1   29.   The method of claim 26 further comprising the step of assigning the unique

2   identifier of the content snapshot of said $(j-1)^{th}$ composite backup $C_{(j-2)(j-1)(j)}$ to be the

3   unique identifier of said restored $(j-1)^{th}$ state snapshot $S_{(j-1)}$.

1   30.   The method of claim 23 further comprising the steps of:

2   creating a $(j-1)^{th}$ precedent backup $B_{(j)(j-1)}$ by copying from said $(j-1)^{th}$

3   state snapshot $S_{(j-1)}$ data blocks identified in said $(j-1)^{th}$ precedent

4   snapshot difference list $S_{(j)(j-1)}$, said $(j-1)^{th}$ precedent backup $B_{(j)(j-1)}$

5   further comprising said $(j-1)^{th}$ precedent snapshot difference list

6               $S_{(j)(j-1)}$;

7   creating a $(j-2)^{th}$ precedent backup $B_{(j-1)(j-2)}$ by copying from said

8               $(j-2)^{th}$ state snapshot $S_{(j-2)}$ data blocks identified in said $(j-2)^{th}$

9   precedent snapshot difference list $S_{(j-1)(j-2)}$, said $(j-2)^{th}$ precedent

10   backup $B_{(j-1)(j-2)}$ further comprising said $(j-2)^{th}$ precedent snapshot

11   difference list $S_{(j-1)(j-2)}$; and

12   creating a first concatenated precedent backup $B_{(j)(j-2)}$ from said $(j-1)^{th}$

13   precedent backup $B_{(j)(j-1)}$ and said $(j-2)^{th}$ precedent backup

14              $B_{(j-1)(j-2)}$ by copying all blocks in said $(j-2)^{th}$ precedent backup

15              $B_{(j-1)(j-2)}$ and by also copying all blocks in said $(j-1)^{th}$ precedent

16   backup $B_{(j)(j-1)}$ not present in said $(j-2)^{th}$ precedent backup $B_{(j-1)(j-2)}$

17   and by copying said precedent difference lists $S_{(j-1)(j-2)}$ and $S_{(j)(j-1)}$

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18 from said precedent backups $B_{(j-1)(j-2)}$ and $B_{(j)(j-1)}$ into said

19 concatenated precedent backup $B_{(j)(j-2)}$.

1 31. The method of claim 30 further comprising the steps of:

2 creating a $(j-3)^{\text{th}}$ precedent backup $B_{(j-2)(j-3)}$ by copying from said

3 $(j-3)^{\text{th}}$ state snapshot $S_{(j-3)}$ data blocks identified in said $(j-3)^{\text{th}}$

4 precedent snapshot difference list $S_{(j-2)(j-3)}$, said $(j-3)^{\text{th}}$ precedent

5 backup $B_{(j-2)(j-3)}$ further comprising said $(j-3)^{\text{th}}$ precedent snapshot

6 difference list $S_{(j-2)(j-3)}$; and

7 creating a second concatenated precedent backup $B_{(j)(j-3)}$ from said first

8 concatenated precedent backup $B_{(j)(j-2)}$ and said $(j-3)^{\text{th}}$ precedent

9 backup $B_{(j-2)(j-3)}$ by copying all blocks in said $(j-3)^{\text{th}}$ precedent

10 backup $B_{(j-2)(j-3)}$ and by also copying all blocks in said first

11 concatenated precedent backup $B_{(j)(j-2)}$ not present in said $(j-3)^{\text{th}}$

12 precedent backup $B_{(j-2)(j-3)}$, and by copying said precedent difference

13 lists $S_{(j-2)(j-3)}$, $S_{(j-1)(j-2)}$, and $S_{(j)(j-1)}$ from said precedent backup

14 $B_{(j-2)(j-3)}$ and said concatenated precedent backup $B_{(j)(j-2)}$ into said

15 concatenated precedent backup $B_{(j)(j-3)}$.

1 32. The method of claim 31 further comprising the steps of:

2 retrieving a concatenated precedent backup $B_{(h)(g)}$, where $g < h \leq n$; and

3 restoring a gth state snapshot S_g by overwriting an hth state snapshot S_h

4 with said concatenated precedent backup $B_{(h)(g)}$.

1 33. The method of claim 23 further comprising the steps of:

2   creating a $(j-1)^{th}$ succedent backup $B_{(j-2)(j-1)}$ by copying from said $(j-1)^{th}$

3   state snapshot $S_{(j-1)}$ data blocks identified in said $(j-1)^{th}$ succedent

4   snapshot difference list $S_{(j-2)(j-1)}$, said $(j-1)^{th}$ succedent backup

5    $B_{(j-2)(j-1)}$ further comprising said $(j-1)^{th}$ succedent snapshot

6   difference list $S_{(j-2)(j-1)}$;

7   creating a jth succedent backup $B_{(j-1)(j)}$ by copying from said j^{th} state

8   snapshot S_j data blocks identified in said j^{th} succedent snapshot

9   difference list $S_{(j-1)(j)}$, said j^{th} succedent backup j^{th} further

10   comprising said j^{th} succedent snapshot difference list $S_{(j-1)(j)}$; and

11   creating a first concatenated succedent backup $B_{(j-2)(j)}$ from said j^{th}

12   succedent backup $B_{(j-1)(j)}$ and said $(j-1)^{th}$ succedent backup

13    $B_{(j-2)(j-1)}$ by copying all blocks in said j^{th} succedent backup $B_{(j-1)(j)}$

14   and by also copying all blocks in said $(j-1)^{th}$ succedent backup

15    $B_{(j-2)(j-1)}$ not present in said j^{th} succedent backup $B_{(j-1)(j)}$, and by

16   copying said difference lists $S_{(j-1)(j)}$ and $S_{(j-2)(j-1)}$.

1 34. The method of claim 33 further comprising the steps of:

2   creating a $(j-2)^{th}$ succedent backup $B_{(j-3)(j-2)}$ by copying from said

3    $(j-2)^{th}$ state snapshot $S_{(j-2)}$ data blocks identified in said $(j-2)^{th}$

4   succedent snapshot difference list $S_{(j-3)(j-2)}$, said $(j-2)^{th}$ succedent

5   backup $B_{(j-3)(j-2)}$ further comprising said $(j-2)^{th}$ succedent snapshot

6   difference list $S_{(j-3)(j-2)}$; and

7   creating a second concatenated succedent backup $B_{(j-3)(j)}$ from said first

8   concatenated succedent backup $B_{(j-2)(j)}$ and said $(j-2)^{th}$ succedent

9   backup $B_{(j-3)(j-2)}$ by copying all blocks in said first concatenated

10   succedent backup $B_{(j-2)(j)}$ and by also copying all blocks in said

11         $(j-2)^{th}$ succedent backup $B_{(j-3)(j-2)}$ not present in said first

12   concatenated succedent backup $B_{(j-2)(j)}$, and copying said difference

13   lists $S_{(j-1)(j)}$, $S_{(j-2)(j-1)}$, and $S_{(j-3)(j-2)}$ from said first concatenated

14   succedent backup $B_{(j-2)(j)}$ and said $(j-2)^{th}$ succedent backup

15         $B_{(j-3)(j-2)}$.

1   35.   An apparatus suitable for protecting the data volume in a computer system, said

2 apparatus comprising:

3   means for acquiring a sequence of state snapshots $S_0, ..., S_j, ..., S_n$ of the

4   data volume, each said state snapshot acquired at a respective time

5         $t_0 < \cdots t_j \cdots < t_n$;

6   means for generating a $(j-1)^{th}$ precedent snapshot difference list $S_{(j)(j-1)}$

7   comprising a list of one or more data blocks of said j^{th} state snapshot

8   S_j identified as differing from data blocks of said $(j-1)^{th}$ state

9   snapshot $S_{(j-1)}$;

10   means for copying from said $(j-1)^{th}$ state snapshot S_{j-1} all the data blocks

11   listed in said $(j-1)^{th}$ precedent snapshot difference list $S_{(j)(j-1)}$ into a

12         $(j-1)^{th}$ precedent backup $B_{(j)(j-1)}$; and

13   means for copying said precedent snapshot difference list $S_{(j)(j-1)}$.

1   36.   The apparatus of claim 35 further comprising means for storing said $(j-1)^{th}$

2 precedent backup $B_{(j)(j-1)}$ in an offline memory means.

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1   37.   The apparatus of claim 36 further comprising:

2   means for retrieving said $(j-1)^{\text{th}}$ precedent backup $B_{(j)(j-1)}$;

3   means for recovering said $(j-1)^{\text{th}}$ precedent snapshot difference list $S_{(j)(j-1)}$

4   from said $(j-1)^{\text{th}}$ precedent backup $B_{(j)(j-1)}$; and

5   means for overwriting at least a portion of said j^{th} state snapshot S_j with at

6   least a portion of the contents of said $(j-1)^{\text{th}}$ precedent backup

7           $B_{(j)(j-1)}$.

1   38.   The apparatus of claim 37 further comprising:

2   means for generating a $(j-1)^{\text{th}}$ succedent snapshot difference list $S_{(j-2)(j-1)}$

3   comprising a list of one or more data blocks of said $(j-1)^{\text{th}}$ state

4   snapshot $S_{(j-1)}$ identified as differing from data blocks of said $(j-2)^{\text{th}}$

5   state snapshot $S_{(j-2)}$; and

6   means for copying from said $(j-1)^{\text{th}}$ state snapshot $S_{(j-1)}$ all the data blocks

7   listed in said $(j-1)^{\text{th}}$ succedent snapshot difference list $S_{(j-2)(j-1)}$ into

8   said $(j-1)^{\text{th}}$ precedent backup $B_{(j)(j-1)}$; and

9   means for copying said $(j-1)^{\text{th}}$ succedent snapshot difference list $S_{(j-2)(j-1)}$.

1   39.   The apparatus of claim 38 further comprising:

2   means for recovering said $(j-1)^{\text{th}}$ succedent snapshot difference list

3           $S_{(j-2)(j-1)}$ from said $(j-1)^{\text{th}}$ precedent backup $B_{(j)(j-1)}$; and

4   means for overwriting at least a portion of said $(j-2)^{\text{th}}$ state snapshot $S_{(j-2)}$

5   with at least a portion of the contents of said $(j-1)^{\text{th}}$ precedent backup

6           $B_{(j)(j-1)}$.

1   40.   The apparatus of claim 35 further comprising:

2   means for concatenating an $(h-1)^{\text{th}}$ precedent backup $B_{(h)(h-1)}$ with an

3        $(h-2)^{\text{th}}$ precedent backup $B_{(h-1)(h-2)}$ through a gth precedent backup

4        $B_{(g+1)(g)}$, where $g < h$, into a concatenated precedent backup $B_{(h)(g)}$;

5   and

6   means for storing said concatenated precedent backup $B_{(h)(g)}$ in an offline

7   memory means.

1   41.   The apparatus of claim 38 further comprising:

2   means for concatenating a $(g+1)^{\text{th}}$ succedent backup $B_{(g)(g+1)}$ with a

3        $(g+2)^{\text{th}}$ succedent backup $B_{(g+1)(g+2)}$ through an hth succedent backup

4        $B_{(h-1)(h)}$, where $g < h$, into a concatenated succedent backup $B_{(g)(h)}$;

5   and

6   means for storing said concatenated succedent backup $B_{(g)(h)}$ in an offline

7   memory means.